The Natural History of HIV-1 Infection in Young Thai Men After Seroconversion

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Summary: The natural history and progression of HIV-1 infection in Thailand and other developing countries in Asia and Africa have not been well defined. Nevertheless, valid data are needed to evaluate the effects of interventions, which are designed to delay progression. We evaluated the progression to AIDS and death in 235 men who seroconverted during their 2 years of service in the Royal Thai Army. The men were conscripted at age 21 and seroconverted within a 6-month window during follow-up while in the military. The seroconverters were matched with men who were seronegative when discharged. Of the HIV-positive men, 156 (66.4%) were alive, 77 (32.8%) had died, and 2 (0.8%) could not be located 5–7 years after their seroconversion and discharge from the military. The 5-year survival rate was 82.3%; the median times to clinical AIDS and a $CD4^+$ cell count of <200/μL was 7.4 years and 6.9 years, respectively. The mortality rate was 56.3 deaths per 1000 patient-years for HIV-positive men and 6.1 deaths per 1000 patient-years for HIV-negative men. Our data suggest a more rapid progression to AIDS and death after HIV-1 infection in young men in Thailand than has been reported for similarly aged cohorts in developed countries.

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In Thailand, the first documented case of AIDS was reported in 1984.[1] During the 1980s, epidemics of HIV infection first involved injecting drug users and commercial sex workers and soon reached people outside these risk groups.[2] By 1999, UNAIDS and WHO estimated that there were ~755,000 people living with HIV infection in Thailand and that about 200,000 had died of AIDS.[3] In Thailand, most HIV infections are due to HIV-1 subtype E (CRF01_AE), and these infections are heterosexually transmitted.[4–6]

Almost all previously reported data about the natural history of HIV-1 from incident cohorts are based on infections in persons from Europe, North America, or Australia, who are predominately infected with subtype B viruses. Very little is known about the natural history of HIV-1 infection in developing countries, including subtype E infections in Southeast Asia. Whether there are differences in the time to onset of AIDS after HIV-1 infection between populations in developed and developing countries or in persons infected with different HIV subtypes is unclear.[7] We studied the natural history of HIV-1 infections in Thailand in a large group of men with known dates of infection.

This study included men who had been enrolled in earlier studies conducted by the Royal Thai Army Medical Department, the Armed Forces Research Institute of Medical Sciences, Chiang Mai University, and The Johns Hopkins University School of Hygiene and Public Health to evaluate the incidence of HIV infection and the risk factors associated with HIV-1 infection among young men recruited into the Royal Thai Army in 1991–1995.[4,8] We evaluated the time to AIDS and death after documented seroconversion while they were in the army.

METHODS

There were 284 HIV-1 seroconverters identified from studies of 7 cohorts of military conscripts who had been en-

rolled in studies on the incidence of HIV infection between 1991 and 1995. These men lived in 30 provinces nationwide after discharge from the Royal Thai Army. Because of logistical reasons, we planed to follow 235 men who lived in provinces with at least 5 seroconverters. All the men in these cohorts were tested for HIV at induction and at 6-month intervals until their discharge 2 years later.[8–11] A comparison group of men who had been seronegative at discharge from the military were also selected for follow-up. They were matched by time of induction into the Royal Thai Army and district of residence 2 years before the induction with men who had seroconverted during their military service. The seronegative men were selected to maintain the confidentiality of the seropositive men and to provide clinical and laboratory data for comparison with data obtained for the seropositive men. Potential participants were contacted and invited to participate in the follow-up study. Individuals who consented to participate were evaluated at a nearby district hospital.

Men were offered enrollment from November 1998 to September 1999. Those men who gave informed consent had a physical examination, phlebotomy, and interview for demographic factors and risk behavior history. Structured questions were used to determine HIV-associated symptoms (eg, fever, night sweats, unexplained weight loss, etc) along with any medical conditions that required treatment since discharge. The latter formed the basis for medical record review. Study personnel who were blinded to the men's HIV-1 serostatus performed blood specimen collection, interviews, and physical examination for both HIV-1 seroconverters and seronegative men. Blood samples were processed within 24 hours of collection and analyzed in the laboratory at the Research Institute for Health Sciences at Chiang Mai University or Armed Forces Research Institute of Medical Sciences in Bangkok, depending on the enrollment site. For those men who had died, their next of kin were interviewed using a standard form to collect information regarding their symptoms to evaluate the causes of death (verbal autopsy).[12] Death certificates were obtained and reviewed.

Laboratory tests included HIV antibody testing by enzyme-linked immunosorbent assay (Organon Teknika, Durham, NC) with Western blot confirmation of positive sera (Diagnostics Biotechnology, Singapore, for Research Institute for Health Sciences; New LAV-Blot1, Sanofi Diagnostics Pasteur, France, for Armed Forces Research Institute of Medical Sciences), determination of complete blood count with an automated count of 10,000 white blood cells, and determination of $CD4^+$ cell count by flow cytometry. In addition, all available baseline serum specimens from 65 seroconverters, which had been collected and stored at −70°C after they became HIV-1 positive when they were in the military, were tested with a quantitative HIV-1 RNA assay (Amplicor HIV-1 Monitor Test, version 1.5; Roche Molecular Systems, Branchburg, NJ) at the Walter Reed Army Institute of Research (Rockville, MD). Serotyping with an HIV-1 V3 loop peptide enzyme immunoassay designed to differentiate HIV-1 subtype E and B viruses[6] was performed on serum samples collected after HIV-1 seroconversion.

Information regarding the medical condition of both the seroconverters and the seronegative participants was obtained by reviewing medical (hospital and autopsy) records and/or death certificates. Physical examination results and self-reported histories of medical conditions were collected for survivors who attended the follow-up clinics. Clinical information about symptomatic HIV infections and AIDS-related events was extracted from the medical records and categorized according to the clinical criteria used in the 1993 Thai AIDS case definition,[13] which is a modification of the 1993 AIDS definition of the Centers for Disease Control and Prevention[14] that includes disseminated *Penicillium maneffei* infection as an AIDS-defining illness.

An AIDS death was defined as a death for which the death certificate or medical record listed AIDS as a cause of death or a death due to HIV infection associated with an AIDS-defining condition, based on review of the medical record. An external traumatic cause of death was defined as a condition not directly related to HIV infection (eg, trauma, drowning, motor-vehicle accident, drug overdose, and suicide).

Statistical Analyses

Analyses were performed using the Statistical Package for the Social Sciences for Windows version 9.0 (SPSS, Chicago, IL). The date of seroconversion for the HIV-1–positive men was defined as the midpoint between the date of the last negative and the date of the first positive HIV-1 enzyme-linked immunosorbent assay.

Censoring Strategies

Because the seroconverters were identified from the cohort studies during 1991–1995, no follow-up of this population had been done until our study. Men had been discharged after they completed their 2 years of military service. The information about the end points (ie, mortality, alive, clinical AIDS, and $CD4^+$ cell count of <200/μL) of the study was ascertained during this evaluation. For those men who were enrolled in the study, observations were right-censored at the date of the last visit. To obtain the vital status of men who we were unable to contact, we searched the National Registration Database System and the Central Population Database of the Ministry of the Interior in October 1999. Those men who were reported to be alive were right-censored on August 1, 1999, because reports of death usually require 2 months to be recorded in this registry.

The studies on the incidence of HIV infection did not include $CD4^+$ cell counts. To assess the time from seroconversion to clinical AIDS and $CD4^+$ cell count of <200/μL, all subjects who died of AIDS whose clinical information could not

be obtained from medical records were considered to have the onset of clinical AIDS or a $CD4^+$ cell count at or below 200/μL at the date of their death. Men who were known to be alive but did not come to the clinic for a follow-up visit, those who were enrolled and had not had clinical AIDS or $CD4^+$ cell counts of <200/μL, and those who could not be traced were right-censored on August 31, 1999.

To estimate the time to AIDS and time to death, the following end points were used: first clinical AIDS diagnosis, $CD4^+$ cell count at or below 200/μL, and deaths due to all causes, deaths due to AIDS, and deaths due to nontraumatic causes. Survival analysis was performed using the Kaplan–Meier method. Overall survival estimates and 95% confidence intervals (CIs) of the estimates were performed for the 235 seroconverters.

This research was reviewed and approved by the Institutional Review Boards of the Thailand Ministry of Public Health, the Royal Thai Army Medical Department, Chiang Mai University, Walter Reed Army Institute of Research, and The Johns Hopkins University Bloomberg School of Public Health.

RESULTS

Study Population

Men in this study lived in 81 districts in 11 provinces and Bangkok. We were able to determine the vital status of 484 (98.7%) of the 490 potential participants in the follow-up study; of the 399 known to be alive, 303 (76%) were enrolled in the study and seen at a clinic. Of the 235 seroconverters, 118 were enrolled in the study, and 77 were deceased. Of the remaining seroconverters, 38 were known to be alive, and the vital status for 2 persons could not be determined. Of the 255 seronegative men, 185 were enrolled in the study, 8 had died, and 58 were known to be alive but did not attend the follow-up clinic; the vital status of 4 persons could not be determined (Table 1). Reasons for nonattendance at the follow-up clinic for the seroconverters known to be alive included moving out of the study area (n = 17), declining to attend a clinic (n = 14), unable to make personal contact (n = 4), and imprisonment (n = 3). The reasons for not attending the follow-up clinic for the seronegative men were moving out of the study area (n = 30), declining to attend a clinic (n = 15), unable to make personal contact (n = 10), and imprisonment (n = 3).

Overall, 99% of the seroconversions in the study group occurred when the men were between 21 and 23 years of age. Approximately 80% of the seroconverters had resided in the upper northern region of Thailand before military service. The rest of the seroconverters were from Bangkok and northeastern Thailand; 96% of the seroconversions occurred during 1991–1993.

For 235 seroconverters, the HIV-1 subtype could be determined by genotype-specific peptide enzyme-linked immunosorbent assay of available serum samples from 185 men; 181 men (97.8%) were infected with subtype E (CRF01_AE), and 4 (2.2%) were infected with subtype B.

Deaths

Death certificates were obtained for 73 (95%) of the 77 seroconverters who died. Deaths occurred between February 1992 and July 1999. AIDS was cited as the cause of death on only 44% (n = 34) of death certificates. After reevaluating the probable causes of death using information from medical records and relative interviews (verbal autopsy), 61 men (79%) were judged to meet the clinical criteria of AIDS as the cause of death. The other causes of death were motor-vehicle accidents (9%), suicide (9%), and drug overdose (2%). Five deaths (7%) could not be evaluated because we could not obtain either a medical record or a relative interview, but the deaths were not attributable to trauma. Figure 1 shows the Kaplan–Meier survival curve of deaths by all causes after HIV-1 seroconversion. The survival was significantly lower than reported from the CASCADE meta-analysis[15] (Table 2). The 5-year survival rate for all causes of death was 82.3% (95% CI, 76.8–86.7). The 5-year survival rate for AIDS death was 87.8% (95% CI, 82.7–

TABLE 1. Status of 490 Potential Participants in a Study of the Natural History of HIV Who Were Grouped by HIV Status During Prior Military Service, 1991–1995

Status of Subjects in 1998–1999	No. (%)		
	HIV-1 Seroconverters	HIV-1– Seronegative Men	Total
Enrolled in study	118 (50.2)	185 (72.5)	303 (61.8)
Did not enroll			
Alive	38 (16.2)	58 (22.8)	96 (19.6)
Dead	77 (32.8)	8 (3.2)	85 (17.3)
Unknown vital status	2 (0.9)	4 (1.6)	6 (1.2)
Total	235 (100)	255 (100)	490 (100)

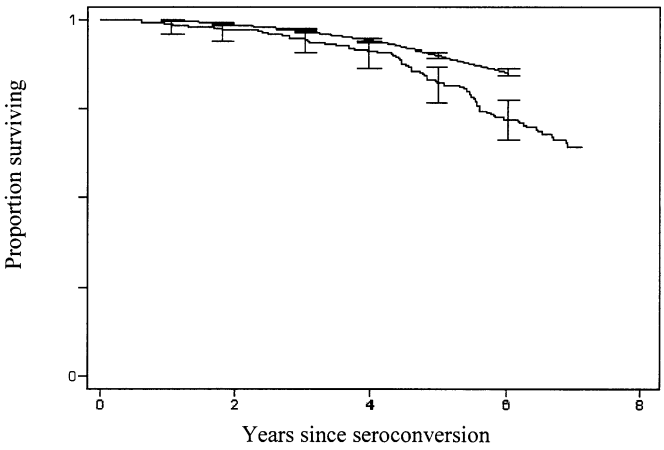

FIGURE 1. Kaplan–Meier estimates and 95% CIs for the proportion of 235 HIV-1 seroconverters surviving all causes of death after HIV-1 seroconversion (lower line) compared with survival estimates and 95% CIs for seroconverters from developed countries in the CASCADE study[15] (upper line).

91.4). The 5-year survival rate for nontraumatic death was 86.9%(95% CI, 81.7–90.7).

All 4 men who were infected with HIV-1 subtype B were known to be alive. Of 3 of them who participated in the follow-up study, 1 had clinical AIDS. The other 2 men had $CD4^+$ cell counts of 354 and 358/μL. The *P* value obtained from the log-rank test comparing the survival between men infected with subtypes E and B was 0.25.

There were 8 deaths in the HIV-1–seronegative group. The seronegative men provided 1309 person-years of follow-up, and the mortality rate for this group was 6.1 deaths per 1000 person-years. The seroconverters provided 1367 person-years of follow-up with 77 deaths, and the mortality rate for this group was 56.3 deaths per 1000 person-years. The rate ratio of death between HIV-1 seroconverters and seronegative men was 9.2 (95% CI, 4.5–19.1).

Status of Participants

Information from medical records, interviews with relatives, and physical examinations for the 235 seroconverters indicated that 85 men had clinical AIDS. Of these men, 61 had died, and 24 had enrolled in the follow-up study. We obtained medical records from hospitals for 101 men; AIDS-defining conditions were described for 37 HIV-1 seroconverters. Fifteen men (23%) had developed wasting syndrome; 12 (19%), pulmonary tuberculosis; 11 (17%), *Pneumocystis carinii* pneumonia; 11 (17%), cryptococcal meningitis; 7 (11%), chronic diarrhea; 2 (3%), cerebral toxoplasmosis; 1 (2%), enteric fever; 1 (2%), tuberculosis of lymph nodes; and 1 (2%) recurrent pneumonia.

Overall, 118 seroconverters were enrolled in the study and completed physical and laboratory evaluations. Twenty-four men had clinical AIDS, and 44 had $CD4^+$ cell counts of <200/μL; 18 men with AIDS had $CD4^+$ cell counts of <200/μL. The median time to clinical AIDS after seroconversion was 7.4 years (95% CI, 6.6–8.1). The median time after seroconversion to a $CD4^+$ cell count of <200/μL was 6.9 years (95% CI, 6.6–7.1). The clinical status of the 118 men evaluated is shown in Table 3.

The distribution of $CD4^+$ cell counts among 118 HIV-1 seroconverters and 182 seronegative participants (excluding 3 men who seroconverted after their military discharge) is shown in Table 4. The mean $CD4^+$ cell count for HIV-1–seronegative men was 767/μL (range, 284–1586/μL) compared with 291/μL (range, 6–1275/μL) for seroconverters.

HIV-1 RNA Levels

HIV-1 RNA levels were quantified in serum samples, which had been collected from 65 HIV-1 seroconverters during the first 6 months after their seroconversion and stored at −70°C. HIV-1 RNA levels were detectable (≥400 copies/mL) in all but 6 subjects. Levels ranged from 798 to ≥750,000 copies/mL. Mean and median HIV-1 RNA values were 74,397 (4.9 log) and 31,906 (4.6 log) copies/mL, respectively. The proportions of all causes of death (30.8%) and AIDS death (29.2%) among this group of 65 seroconverters who had stored serum specimens available were not statistically different from those for the total population of 235 seroconverters ($P = 0.15$ and $P = 0.71$, respectively), suggesting that this subpopulation probably was representative of the total population.

Treatment and Prophylaxis

The medical records indicated that only 2 of the seroconverters had been treated with antiretroviral drugs; both had received zidovudine alone. Only 2 men had received isoniazid prophylaxis for tuberculosis, and 12 men had received trimethoprim–sulfamethoxazole prophylaxis.

DISCUSSION

In this study of 235 young Thai men whose HIV-1 seroconversion was documented within a 6-month interval, we found a mortality rate of 56.3 deaths per 1000 person-years, which was >9-fold higher than that for men who were HIV-1 seronegative. The mortality rate of 18% 5 years after HIV-1 infection was about twice that reported by the CASCADE study, a meta-analysis of 13,030 HIV-1–infected individuals from 38 cohorts from Western developed countries where the date of seroconversion could be reliably estimated.[15] Subjects in these cohorts were enrolled before the availability of highly active antiretroviral therapy. The CASCADE study estimated that the median time to AIDS for subjects 15 to 24 years of age was 11.0 years (95% CI, 10.7–11.7). We estimated that the median time from HIV-1 seroconversion to clinical AIDS was only 7.4 years (95% CI, 6.6–8.1). Our data suggest that progression to AIDS and death after HIV-1 infection is more rapid

TABLE 2. Comparison of Survival After HIV-1 Seroconversion Between Young Thai Male Seroconverters and Seroconverters From Developed Countries

		This Study†		
Years Since Seroconversion	Proportion (%) Surviving (95% CI) CASCADE Analysis*	Proportion (%) Surviving (95% CI)	No.	No. Deaths
1	99.7 (99.5–99.8)	98.7 (96.1–99.6)	231	3
2	98.6 (98.3–98.9)	97.0 (93.8–98.6)	227	4
3	96.9 (96.5–97.3)	94.9 (91.1–97.0)	222	5
4	94.2 (93.6–94.8)	91.0 (86.5–94.0)	213	9
5	90.2 (89.3–91.0)	82.3 (76.8–86.7)	189	20
6	85.2 (84.0–86.3)	71.9 (65.6–77.3)	147	23
7	79.5 (71.2–74.8)	64.1 (56.7–70.5)	56	11

*25–29 years of age at seroconversion.[15]
†21–23 years of age at seroconversion.

in young men in Thailand than has been reported for comparably aged populations in developed countries in North America, Europe, and Australia.[15–22] In addition, our data suggest that the mortality rate (6.1 deaths per 1000 person-years) among HIV-negative young men in Thailand may be increased compared with that among Western populations.

It was often difficult to estimate the time of the first AIDS diagnosis from the available medical records. Therefore, we analyzed both the time to a clinical AIDS diagnosis and the time to the first $CD4^+$ cell count of <200/μL. To obtain a more robust estimate of the time to the first $CD4^+$ cell count of <200/μL, we imputed the date of the first $CD4^+$ cell count of <200/μL to be 1 year before the date of death for the 61 men whose first $CD4^+$ cell counts were <200/μL. We found that the median time to the first $CD4^+$ cell count of <200/μL was 6.9 years (95% CI, 6.6–7.1), which was not significantly different than the estimate before the imputation. With regard to the time to a clinical AIDS diagnosis after imputation of the date of the onset of clinical AIDS was applied, the 7-year AIDS-free rate was 57.0% (95% CI, 48.8–64.4), while it was 56.0% (95% CI, 47.6–63.5) from the estimate in which the date of the onset of clinical AIDS for 61 men with AIDS deaths was assumed to be the date of their deaths.

We identified dates of AIDS diagnoses based on the medical record review from various community hospitals nationwide. The median time after an AIDS diagnosis to death for 39 men whose AIDS diagnosis could be ascertained from medical records was only 56 days. This estimate was shorter

TABLE 3. Status of 118 HIV-1 Seroconverters by 1993 Centers for Disease Control and Prevention Classification for Adolescents and Adults

Category*	No. (%)
1A	9 (7.6)
1B	5 (4.2)
2A	40 (33.9)
2B	14 (11.9)
2C	6 (5.1)
3A	19 (16.1)
3B	7 (5.9)
3C	18 (15.3)
Total	118 (100)

*Category 1 indicates $CD4^+$ T lymphocyte count of ≥500/μL; category 2, $CD4^+$ T lymphocyte count of 200–499/μL; category 3, T lymphocyte count of <200/μL; category A, asymptomatic infection; category B, symptomatic conditions in HIV-positive persons; category C, clinical AIDS.

TABLE 4. Comparison of $CD4^+$ Cell Counts Between HIV-1 Seroconverters and Seronegative Men That Were Measured During 1998–1999

	No. (%)	
Absolute $CD4^+$ Cell Count (μL)	HIV-1 Seroconverters	HIV-1–Seronegative Men
5–50	15 (12.7)	—
51–100	7 (5.9)	—
101–200	22 (18.6)	—
201–500	60 (50.8)	23 (12.6)
501–1000	13 (11.0)	131 (72.0)
1000–1500	1 (0.8)	26 (14.3)
>1500	—	2 (1.0)
Total	118 (100)	182 (100)
Mean (μL)	291.2	767

than the survival of adult Thai patients with AIDS reported from an infectious diseases hospital in Bangkok by Kitayaporn et al,[23] who found a median survival time after an AIDS diagnosis of 7.3 months. The predominately rural population in our cohort may have sought medical care and been diagnosed with AIDS later in their illness than the Bangkok population.

Previously reported data are conflicting on whether progression after HIV-1 infection in persons in developing countries is more rapid than in developed countries, and data for Asian populations are sparse. In 1990, Nagelkerke et al[24] using a Markov model estimated that the mean time for transition from seroconversion to CDC stage IV was about 3 years for female sex workers in Nairobi, Kenya. In 1995, Anzala et al[25] reported an estimated median duration to CDC stage IV-C disease of 4.4 years for the same population of female sex workers. However, other groups of investigators reported data suggesting there is not more rapid disease progression in populations in developing countries. In 1997, Morgan et al[26] reported survival from the follow-up of seroincident and seroprevalent cases of HIV-1–infected persons in Uganda. They found that among the seroincident group the cumulative progression to AIDS was 22% at 5 years after seroconversion. They concluded that the time to AIDS in their study population was similar to that in cohorts of homosexual men in developed countries (ie, 21–30% at 5 years). In 1999, French et al[27] reported results of a survival study of a seroprevalent cohort in Entebbe, Uganda; they suggested that there was not evidence of more rapid progression in HIV-1–infected adults than had been reported for cohorts in developed countries.[28] However, both of these study populations included only persons with prevalent HIV-1 infections; therefore, the duration of their infection at enrollment was uncertain. Precise conclusions about the rate of disease progression cannot be drawn from data for seroprevalent cohorts, because persons who progressed most rapidly after seroconversion may have been excluded.

A study from Malawi reported on the long-term follow-up of 197 HIV-positive individuals and 396 age- and sex-matched HIV-negative individuals and their spouses.[29] The death rate was 93.3 deaths per 1000 person-years for the HIV-positive individuals and 11.3 deaths per 1000 person-years for the HIV-negative individuals. Although the mortality rate among both the HIV-positive and HIV-negative individuals in Malawi was higher than that among the young men in our study in Thailand, the relative mortality rate associated with HIV infection was similar in the 2 studies. A study of disease progression and survival in 194 female sex workers in northern Thailand was reported by Kilmarx et al.[30] They found a median time to 25% mortality of 6.9 years. For 34 participants with incident infections, the 5-year survival was 77.8%, which is quite similar to our data. To our knowledge, this is the only other reported study from Thailand.

The low rate of chemoprophylaxis for opportunistic infection among our study population reflects the limitations of medical care for HIV-1–infected persons in Thailand in the mid-1990s and late entry into the medical care system of many HIV-infected persons.[31] The near absence of prophylaxis for opportunistic infections for these men could partially explain the shortened survival but does not explain the more rapid progression before an indication for prophylaxis. A study from Brazil suggested that isoniazid prophylaxis for HIV-positive patients was associated with improved survival.[32] An earlier study of AIDS patients before the availability of antiretroviral drugs found that prophylaxis with trimethoprim–sulfamethoxazole was associated with improved survival.[33] Recently, Thailand has developed national guidelines for the clinical management of HIV infection, which emphasize the use of appropriate chemoprophylaxis for these patients.[34] Hopefully, the proportion of HIV-infected patients who receive prophylaxis will increase in the future.

An interesting finding from our study was the relatively high HIV-1 RNA levels in the serum samples after seroconversion in comparison with reports for Western cohorts. In several studies from Western countries, the HIV-1 loads in infected injection drug users[17,18] and hemophilia populations[19,20] were lower at steady state after infection than those in persons who were infected from sexual contact.[21,22] However, in persons infected in Thailand from sexual exposure, both from our study in which 95.6% of men reported sexual contact as the risk behavior (data not shown) and among female sex workers,[30] levels of HIV-1 RNA were high compared with those in seroconverters from the Multicenter AIDS Cohort Study.[21]

Hu et al[35] found that viral loads in seroconverters in Thailand who were infected with subtype E were higher in the first 6–12 months after infection than in those infected with subtype B viruses. However, the viral loads and decline in $CD4^+$ cell counts were similar at 12 and 24 months. These data raise the possibility that initial viral load and possibly progression after HIV infection may differ in association with HIV-1 subtype. Supporting this hypothesis is the report of slower progression to AIDS in sex workers in Senegal who were infected with HIV-1 subtype A compared with other subtypes.[36]

We found that the absolute $CD4^+$ cell counts for HIV-1–seronegative young Thai men were significantly lower (mean, 764/μL) than those reported from the Multicenter AIDS Cohort Study[21] (mean, 988/μL). Other investigators also reported lower $CD4^+$ cell counts for HIV-1–negative adult male populations in Thailand than for populations in the United States.[37] Lower baseline $CD4^+$ cell counts might be 1 factor accounting for a more rapid decline to $CD4^+$ cell counts of <200/μL after HIV infection in Thai males.

In summary, our data for young Thai men who were followed 5–7 years after they were infected with HIV-1 suggest that progression to AIDS and death may be significantly faster than has been reported for cohorts in developed countries. Factors contributing to the more rapid progression could include

host immune responses, viral characteristics, and infrequent use of prophylaxis for opportunistic infections, although the latter is less likely a factor in progression to AIDS than to death. These data on the natural history of HIV-1 subtype E (CRF01_AE) infections in Thailand can serve as a useful reference in the evaluation of interventions to prevent or delay disease progression in infected individuals. These data also will be critical in the assessment of the possible impact of vaccine on the course of disease in volunteers with breakthrough infections in Thai phase 3 HIV-1 vaccine trials.

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